Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Hour \_\_\_\_\_\_\_\_\_\_ Group # \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Yeast Lab 2 - Temperature**

**BACKGROUND:**

In our last yeast investigation, you learned what yeast, living fungus cells, like to eat most. We tested salt, flour, sugar, and artificial sweetener.

1. Which foods caused the biggest change in the yeast bags?
2. What did this change look like? (How did we know what the yeast liked eating?)

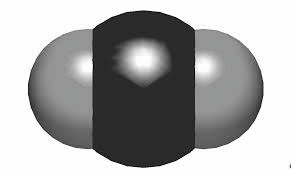
Yeast are not plants or animals, but they are living things. Therefore, they need and use energy. Think about what we have been learning in class about photosynthesis and respiration and how these two reactions help the organism use and make energy. Write the equations for each in the spaces below using words from the word bank.

**Water (H2O)**

**Glucose/Sugar/Food**



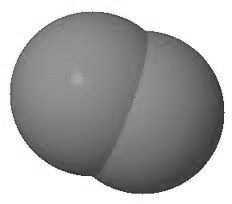
**Light Energy**



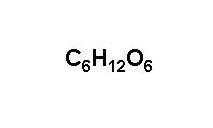
**Carbon dioxide (CO2)**



**ATP Energy**



**Oxygen (O2)**



1. **Photosynthesis**: *Write or draw* the items from above into the boxes to create the process of photosynthesis. \*You will not use all 6 pictures\*

Reactants Products

1. **Respiration**: *Write or draw* the items from above into the boxes to create the process of respiration. \*You will not use all 6 pictures\*

Reactants Products

1. Why do you think we use yeast to make bread? Explain (Hint: Look at the products above)

When oxygen is not available, many organisms, such as yeast, can still carry out respiration to get energy for their cells. Respiration without oxygen is called fermentation, and results in a new product. Find and circle it in the reaction below:

**Respiration without Oxygen (Fermentation)**

Sugar → Carbon Dioxide + Alcohol + Energy

1. Why do you think we use yeast to make beer? Explain (Hint: Look at the products above)

The presence or absence of oxygen is not the only variable to consider when using yeast to make food products. As with all organisms, yeast perform best under certain **temperature** conditions. **In this investigation, you will find the optimal temperature range for yeast respiration.**

**PREDICTIONS:**

1. Based on what you learned in class and from the earlier yeast investigation, what product do you think will result when you mix **yeast, water,** and **sugar**? (Hint: Are they doing photosynthesis or respiration?)
2. What do you think you will see as a result of this chemical reaction? (What will happen?)

**TESTABLE QUESTION:**

1. What question are we trying to answer?

**VARIABLES:**

1. The independent variable for an experiment is the factor that you change on purpose. What is the **independent variable** for your experiment?
2. The dependent variable (responding variable) is the variable that **might** change as a result of a change in the independent variable. The dependent variable is the data that is observed and measured in an experiment. What is the **dependent variable** for this experiment?
3. In a controlled experiment (fair test) all other factors are kept the same so that you can fairly compare the results from the control and the experimental groups. Name three factors that should be kept **constant** (the same) all the way through the experiment for all test groups:

1.

2.

3.

**HYPOTHESIS:**

Your hypothesis is your prediction of what you think will happen when you do the investigation. It is written in the “If”, “then”, “because” format.

If (I do this) (IV)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_,

then (this will happen) (DV)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_,

because (what I think)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**MATERIALS:**

* Hot water: ~70**°**C (10 mL)
* Warm water: ~25**°**C (10 mL)
* Cold water: ~5**°**C (10 mL)
* Dried yeast cells (0.75 g)
* Table sugar (1.0 g)
* Large test tubes
* 25-mL Graduated cylinder
* Small paper cups
* Styrofoam hot cups
* Timer
* Scale
* Plastic pipettes
* Wooden stirring sticks
* Thermometers
* Ruler (cm)
* Sharpie

**PROCEDURE:**

**Overview**

Each group will need 3 test tubes, 3 small paper cups, and 3 Styrofoam cups. Each group will prepare 3 test samples, one with cold water, one with warm water, and one with hot water. The water, yeast, and sugar will be mixed together first in small paper cups. Each cup, once fully mixed, will be carefully poured into 3 large test tubes. Each test tube will sit inside a Styrofoam cup containing water of the same temperature as is in that test tube. A thermometer will be placed into each Styrofoam cup. At five-minute intervals, both the temperature and the height of the foam formed in each tube will be recorded. Continue recording for up to 30 minutes.

**Tube 3**

Hot

**Tube 2**

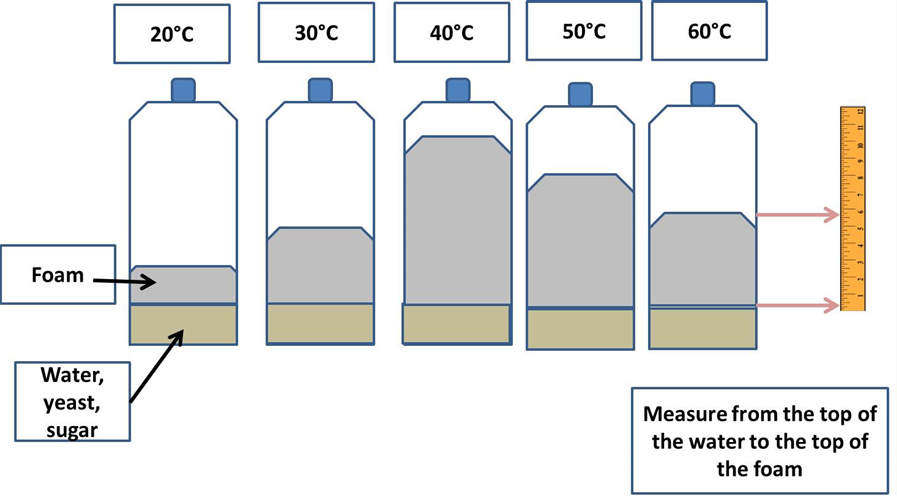
Warm

**Tube 1**

Cold

**Step-By-Step**

1. Label each cup and tube with the Sharpie as above.
2. Add 10-mL cold water into cup 1, 10-mL hot water into cup 3, and 5-mL cold water + 5-mL hot water into cup 2.
3. Add 0.75 g dried yeast into each cup. Mix well so that the yeast dissolves.
4. Add 1.0 g of sugar to each cup and again, mix well.
5. Pour each well-mixed cup into the correctly labeled test tube.
6. Place each test tube into the correctly labeled Styrofoam cups.
7. Start your iPad timer.
8. Add enough cold water to the “cold” Styrofoam cup so that the water-yeast-sugar mixture is fully submerged.
9. Add enough hot water to the “hot” Styrofoam cup so that the water-yeast-sugar mixture is fully submerged.
10. Add enough warm water to the “warm” Styrofoam cup so that the water-yeast-sugar mixture is fully submerged.
11. Record starting temperatures for each cup and 0 cm for the foam height.
12. At 5-minute intervals, record the temperature and measure the height of the foam in cm. (see diagram below).



Foam

Yeast + Water + Sugar

**OBSERVATIONS:**

1. Fill in the following table with your observations of each test tube. Make observations over several time periods. Remember, observations should include **quantitative** (numbers and measurement) and **qualitative** (qualities) information**.**

|  |  |  |
| --- | --- | --- |
|  | Time (minutes) | Observations |
| **Cold** | 5 |  |
| 10 |  |
| 15 |  |
|  | 20 |  |
|  | 25 |  |
|  | 30 |  |
| **Warm** | 5 |  |
| 10 |  |
| 15 |  |
|  | 20 |  |
|  | 25 |  |
|  | 30 |  |
| **Hot** | 5 |  |
| 10 |  |
| 15 |  |
|  | 20 |  |
|  | 25 |  |
|  | 30 |  |

**RESULTS:**

Take a side-by-side picture of your test tubes when you start the investigation and again at the end. Put them in the same order for both pictures (ex. **Cold**, **Warm**, **Hot**).

Beginning Picture

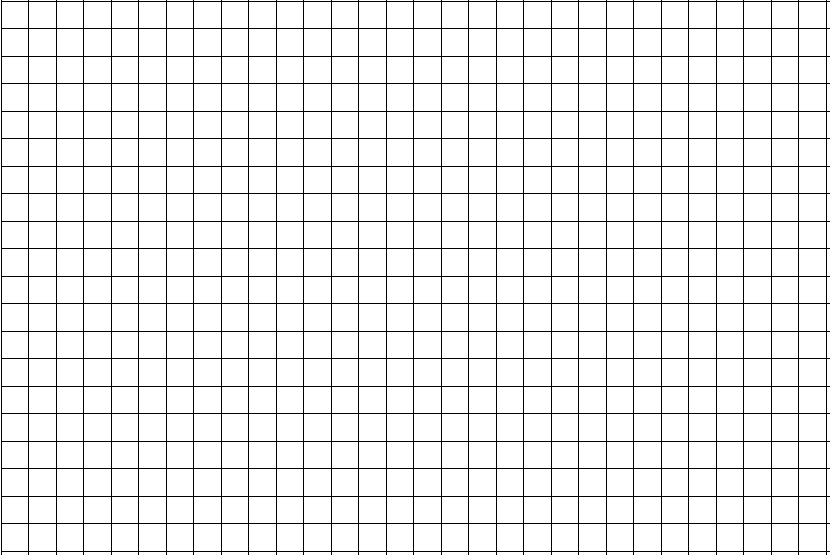
End Picture

**Data Chart:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Cold** | | **Warm** | | **Hot** | |
| **Time (min)** | **Temp (°C)** | **Foam Height (cm)** | **Temp (°C)** | **Foam Height (cm)** | **Temp (°C)** | **Foam Height (cm)** |
| 0 |  | 0 |  | 0 |  | 0 |
| 5 |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |
| 15 |  |  |  |  |  |  |
| 20 |  |  |  |  |  |  |
| 25 |  |  |  |  |  |  |
| 30 |  |  |  |  |  |  |

1. Create a graph of your results. Don’t forget to **add labels** and a KEY for the 3 colors you will need to use (**Cold**, **Warm**, **Hot**).

Title\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



**Key**

**Cold**

**Warm**

**Hot**

1. Which test tube produced the most gas?
2. *Why* do you think this happened? Explain.

**COMPARATIVE CLASS DATA**

You will now have a chance to look at the results of the other groups in the classroom. Use the table below to record your observations. Then, gather together with you group and decide which variable caused the most gas production.

1. Which test tube produced the most gas?

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Cold** | **Warm** | **Hot** |  |  | **Cold** | **Warm** | **Hot** |
| Group 1 |  |  |  |  | Group 5 |  |  |  |
| Group 2 |  |  |  |  | Group 6 |  |  |  |
| Group 3 |  |  |  |  | Group 7 |  |  |  |
| Group 4 |  |  |  |  | Group 8 |  |  |  |

**CONCLUSIONS:**

**Using the writing prompts, write three concluding paragraphs.**

**Paragraph 1:**

Our hypothesis that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (WAS or WAS NOT) supported by experimental data. Our data showed that \_\_\_\_\_\_ cm of foam was formed at \_\_\_\_\_ °C while **only** \_\_\_\_\_\_\_\_\_ cm was formed at \_\_\_\_\_ °C and \_\_\_\_\_\_cm was formed at \_\_\_\_\_ °C. Based on our knowledge of cellular respiration, we conclude that the foam is bubbles of \_\_\_\_\_\_\_\_\_\_\_\_\_. We think this because \_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

As a result of this experiment, one conclusion we can draw about yeast respiration is \_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Paragraph 2:**

Describe two things that could improve the reliability of this experiment, meaning the quality of your data. (How could **the lab** be written better?)

Describe at least two sources of error that may have affected ***your* results** and how you would correct this in a future experiment. (What could **you** have done better?)

Write down two new ideas you have for a future experiment involving yeast. (What else would you like to try or know?)

**Paragraph 3:**

Based on the data collected, we can conclude that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ appears to be the optimal temperature range for yeast respiration. We conclude this because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Yeast produce \_\_\_\_\_\_\_\_\_­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ during cellular respiration which was measured in the experiment by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.